

NASA/Tropical Rainfall Measuring Mission (TRMM)

Topic #3: El Nino/La Nina

Teacher's Guide

Grades: 6-9

Overview: This topic is designed to increase students' understanding of the relationship between high and low pressure systems in the atmosphere over the Pacific Ocean, and their role in creating an El Nino or La Nina event. A narrative summary explains that as global winds blow from a high pressure area to a low pressure area, they drag surface water with them. In the case of a La Nina event the winds push warm water to the west, away from northwestern South America and toward a low pressure area in the western Pacific. To replace the warm water, cooler water from below rises bringing up nutrients from the bottom. This cold current is called upwelling and stimulates the food chain. The cooler water also produces drier regional weather.

When an El Nino event occurs the conditions reverse. The high and low pressure systems switch locations, and the winds weaken which no longer pull the warm water away from South America. Without the upwelling of cold water and its nutrients, the food chain collapses. As the warm water lingers near the coast it warms the air which rises to cool and return as rain.

Activity #1 provides the students with background information through a summary that includes key vocabulary words and a diagram featuring the major components of a La Nina and El Nino event. To support their understanding of a La Nina event, Activity #2 suggests a teacher demonstration which utilizes a layer of cool blue water at the bottom of a plastic shoe box and a hair dryer to model the increased strength of the Trade Winds and the resulting upwelling. Background for discussion of the brief demonstration is provided. Activity #3 requires students to interpret TRMM's satellite observation of sea surface temperatures. Student response sheets are provided on which students may record their interpretation activities.

National Science Education Content Standards: The activities provided in this lesson meet Content Standards A,B,C,D,E,F and G. A comprehensive list of the Content Standards and relevant subtopics is located on page 4 of the Teacher's Guide.

Activity #1: Narrative Summary- La Nina/El Niño

- **Objective:** To interpret summary information and a diagram explaining the interaction between pressure systems, prevailing winds and ocean currents that lead to a La Niña or El Niño event.
- **Type of Activity:** Students read a narrative summary and interpret an accompanying diagram. Students are instructed to generate a list of events leading to La Nina. They also classify a list of events as to whether they are related to La Nina or El Nino.

- **Background** –Major points are explained in a narrative summary in which key vocabulary words are bold-faced.
- **Vocabulary** – Bold-faced vocabulary words in the “Background” are defined
- **Materials** –One copy of the 4 page lesson per student to include the summary, vocabulary, diagram and student response sheet. The diagram may be duplicated or made into a transparency for group discussion.
- **Procedure**- Instruct students to read the summary to determine how surface winds could cause cool water to rise up near the northwestern coast of South America. Tell them this is called La Nina. Ask them to list the events that lead to a La Nina event on their “Student Response Sheet”. Suggested responses are listed in the “Answers” section below. Further discussion might include how this upwelling affects marine life (**the nutrients brought up by the upwelling stimulate the food chain**), and its affect on global weather (**drier in northwestern South America, increased rain in the western Pacific**). A similar discussion could feature the key points for the development of El Nino and the role of NASA’s TRMM satellite. To demonstrate the upwelling of La Nina and utilize TRMM images, follow this lesson with Activity #2.
- **Answers** – to “Student Response Sheet”

Part I. READING WITH A PURPOSE

1. Low pressure area develops in Australia
2. Trade Winds strengthen as they move toward the low pressure
3. Warm surface water is pushed westward from South America by Trade Winds.
4. Cold water upwelling replaces the warm water

Part II: INTERPRETATION OF SUMMARY AND DIAGRAMS

Write an “E” in front of statements that apply to *El Niño* and write an “L” in front phrases that apply to *La Niña*.

- L ____ 1. Upwelling of cold water develops near northwestern South America
E ____ 2. Warm equatorial water spreads eastward.
L ____ 3. There is an abundance of phytoplankton and fish.
L ____ 4. Atlantic hurricanes can move westward and strengthen.
E ____ 5. The tops of developing Atlantic hurricanes are sheared off.
E ____ 6. The Trade Winds are weakened.
L ____ 7. Drier conditions develop in southern United States.
L ____ 8. Warm equatorial surface water is blown westward by strong Trade Winds.
E ____ 9. Floods may occur in northwestern South America.
L ____ 10. Tahiti experiences a high pressure system.
E ____ 11. Northern Australia may have less than normal rainfall.
L ____ 12. The name of this event could be translated to mean “the little girl”.
E ____ 13. This presence of this coastal warm water is named after the Christ Child.

Activity #2: Demonstration -El Nino/ La Nina

- **Objective:** To model the interaction between prevailing winds and ocean currents that cause upwelling of cold water.
- **Type of Activity:** Teacher demonstrates cold water upwelling. A hypothesis and concluding observations are drawn and labeled on a chalkboard. Cross-section diagrams of La Nina and El Nino with discussion notes of weather related phenomenon are provided.
- **Materials:** clear plastic shoe box, long neck funnel, blue food coloring, warm & cold water, hair dryer, one piece of white paper, 50mL beaker, transparency of diagrams or copies for students, chalkboard
- **Procedure:** Follow the instructions for the demonstration. Have a student record a hypothesis on the chalkboard. At the conclusion of the demonstration ask a volunteer to draw their observations. In a group discussion, label the illustration. Distribute copies of the diagrams or use a transparency. Use the discussion notes to explain weather related phenomena and upwelling on the diagrams.
- **Discussion Points:** Cross-section diagrams of La Nina and El Nino are provided with discussion notes related the upwelling and weather related phenomenon. This page could be made into a transparency or duplicated for each student.

Activity #3: Satellite Interpretation -El Nino/ La Nina

- **Objective:** To interpret a 1997-1998 Anomaly Map of sea surface temperatures
- **Type of Activity:** students analyze a NASA/TRMM satellite image of sea surface temperatures of 1997-1998 Global Ocean Anomalies.
- **Materials:** a copy of Activity #3, a computer with Internet Access or color copies of the TMI Anomaly Map Product (<http://www.ssmi.com/tmiAnomaly.html>)
- **Procedure:** Distribute copies of Activity #3. Review the temperature values assigned to the color key. Explain that the colored maps are not the images 'seen' by the satellite, but instead they represent the data which has been collected. Temperature values have been assigned a color as a means of conveying the information. Provide instructions to use the Internet to access the site address or distribute color copies of images. After individual interpretation, discuss findings as a group.
- **Answers**
 1. Warmest to coolest the colors are red, yellow, light blue, dark blue and purple.
 2. Yellow
 3. It is located in the eastern half of the Pacific along the Equator.
 4. It has decreased in size.
 5. The temperature is 1 or 2 degrees above normal
 6. December 97; April 98
 7. February 98; December 97
- **Related Internet Address:**

U.S.Department of Commerce/NOAA/PMEL/TAO/ El Nino theme Page
<http://www.pmel.noaa.gov/toga-tao/la-nina-story.html>

National Science Education Standards

The NASA/TRMM Activities support the following standards:

CONTENT STANDARDS; Grades 5-8

A. Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B. Physical Science

- Properties and changes of properties in matter
- Transfer of energy

C. Life Science

D. Earth and Space Science

- Structure of the Earth

E. Science and Technology.

- Abilities of technological design
- Understandings about science and technology

F. Science in Personal and Social Perspectives

- Natural Hazards
- Science and technology in society

G. History and Nature of Science

- Science as a human endeavor
- Nature of science

CONTENT STANDARDS; Grades 9-12

A. Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B. Physical Science

- Structure and properties of matter
- Interactions of energy and matter

C. Life Science

D. Earth and Space Science

- Structure of the Earth
- Geochemical cycles

E. Science and Technology.

- Abilities of technological design
- Understandings about science and technology

F. Science in Personal and Social Perspectives

- Natural and human-induced hazards
- Science and technology in local, national and global challenges

G. History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge